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(54) **METHOD FOR IMPLEMENTING SPECIFIC TERMINATION CAUSE CODES IN TERMINATION REQUESTS**

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H04W 76/06 (2009.01)
(52) **U.S. Cl.**
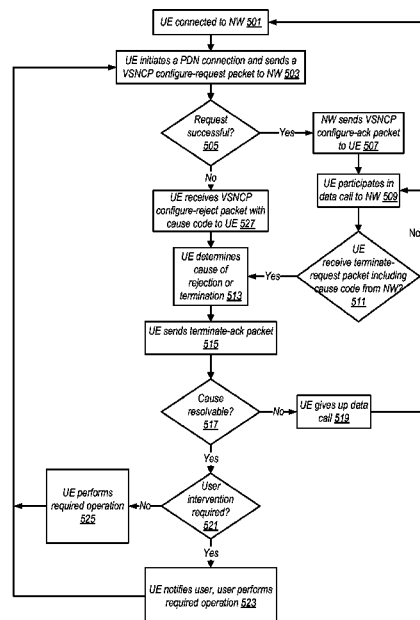CPC *H04W 76/062* (2013.01)
(58) **Field of Classification Search**
CPC H04B 1/44; H04B 7/0404; H04W 24/02; H04W 36/14; H04W 88/16
See application file for complete search history.

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(57) **ABSTRACT**

A method includes a wireless mobile device communicating with a wireless network via an evolved high rate packet data (eHRPD) interface. The wireless mobile device may receive a vendor specific network control protocol (VSNCP) packet such as a terminate-request packet, for example, that indicates the wireless network has requested a PDN disconnection. The VSNCP packet includes a cause code that indicates a reason for the PDN disconnection request. The wireless device may use the cause code to determine the reason for the PDN disconnection request. Accordingly, in response to receiving the VSNCP packet, the wireless mobile device may perform one or more operations in an effort to resolve any issues that may have caused the PDN disconnection request.
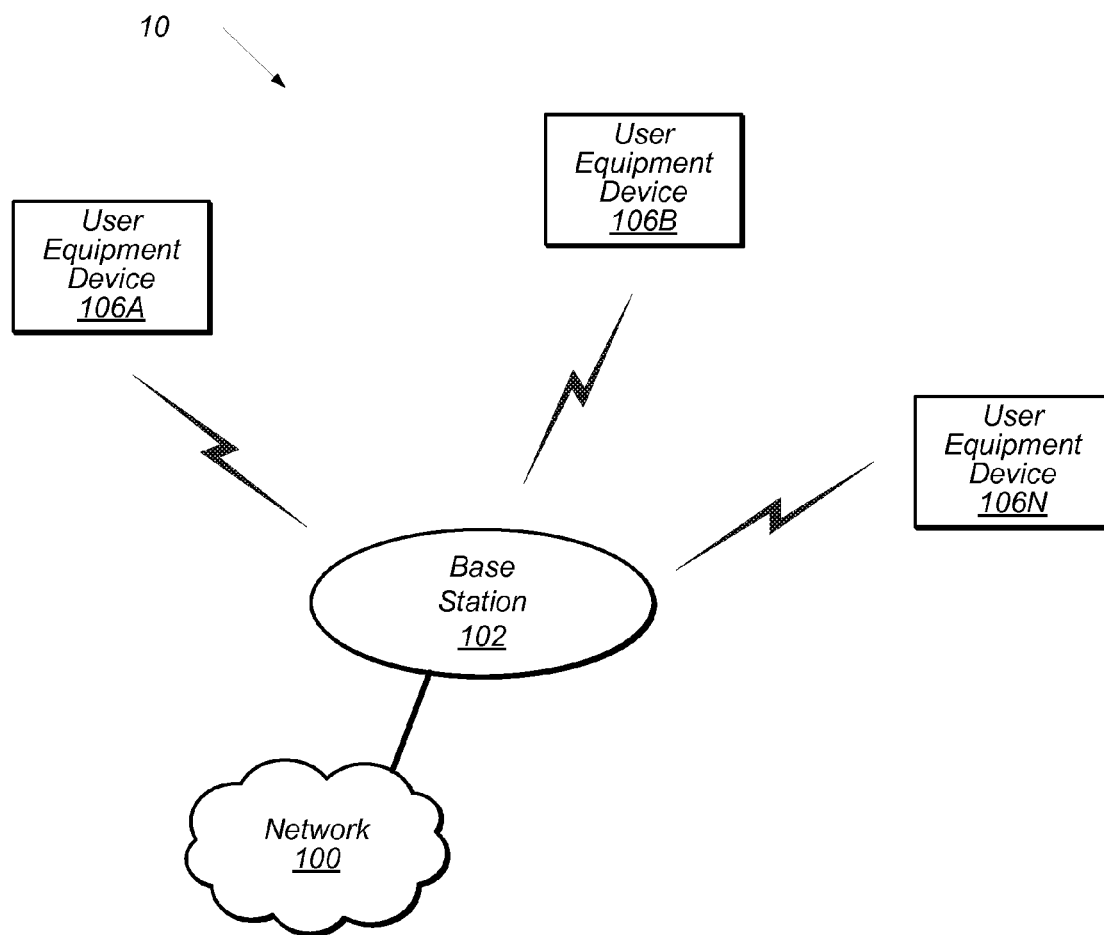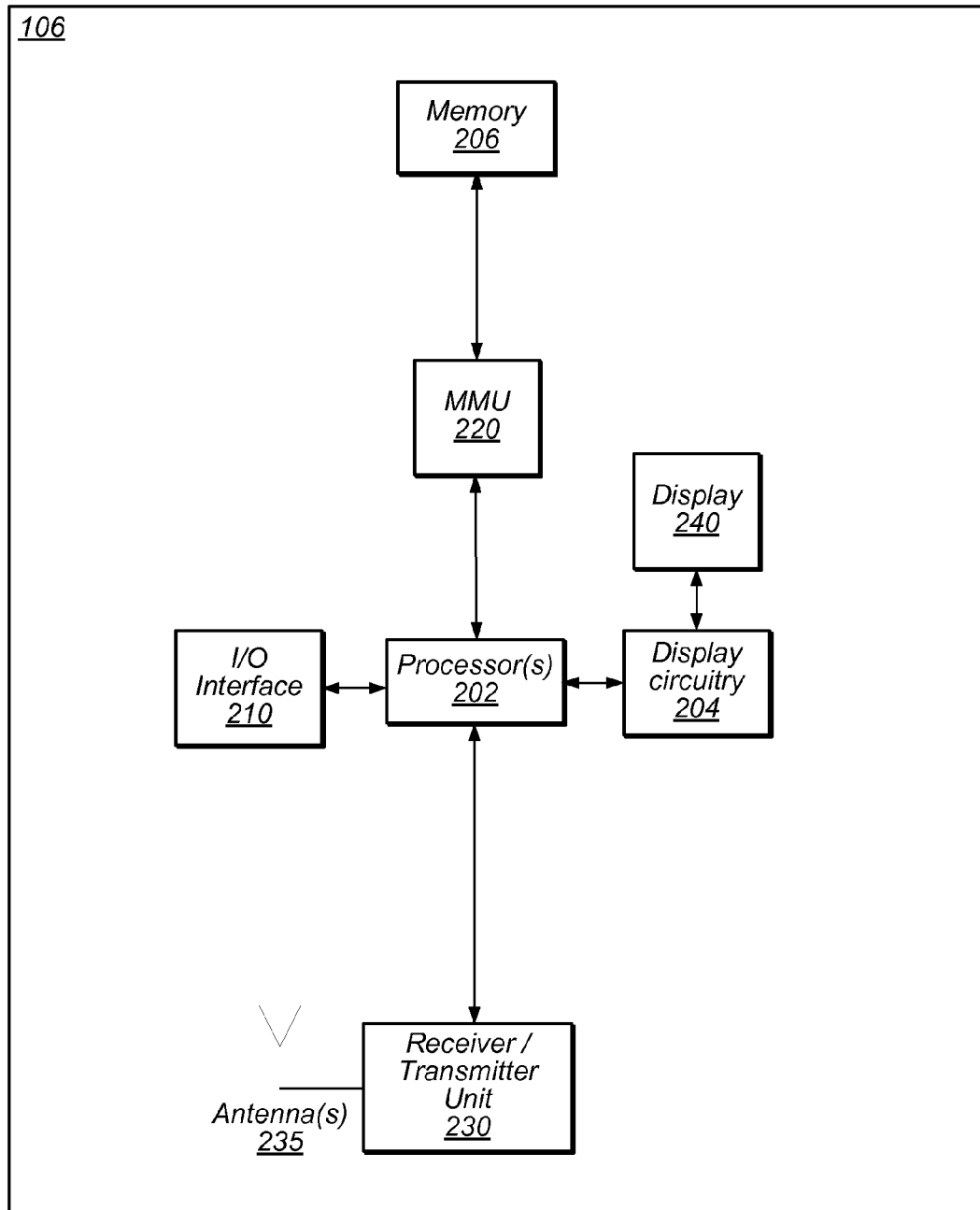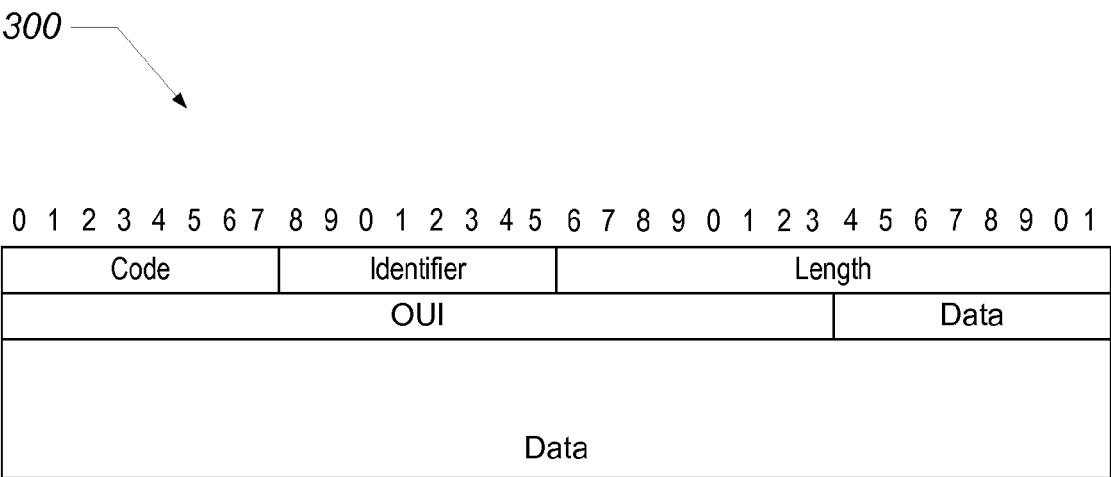
20 Claims, 6 Drawing Sheets

10

User
Equipment
Device
106A

User
Equipment
Device
106B

User
Equipment
Device
106N

Base
Station
102

Network
100

FIG. 1

FIG. 2

300

0 1 2 3 4 5 6 7	8 9 0 1 2 3 4 5	6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1
Code	Identifier	Length
OUI		Data
Data		

Legend:

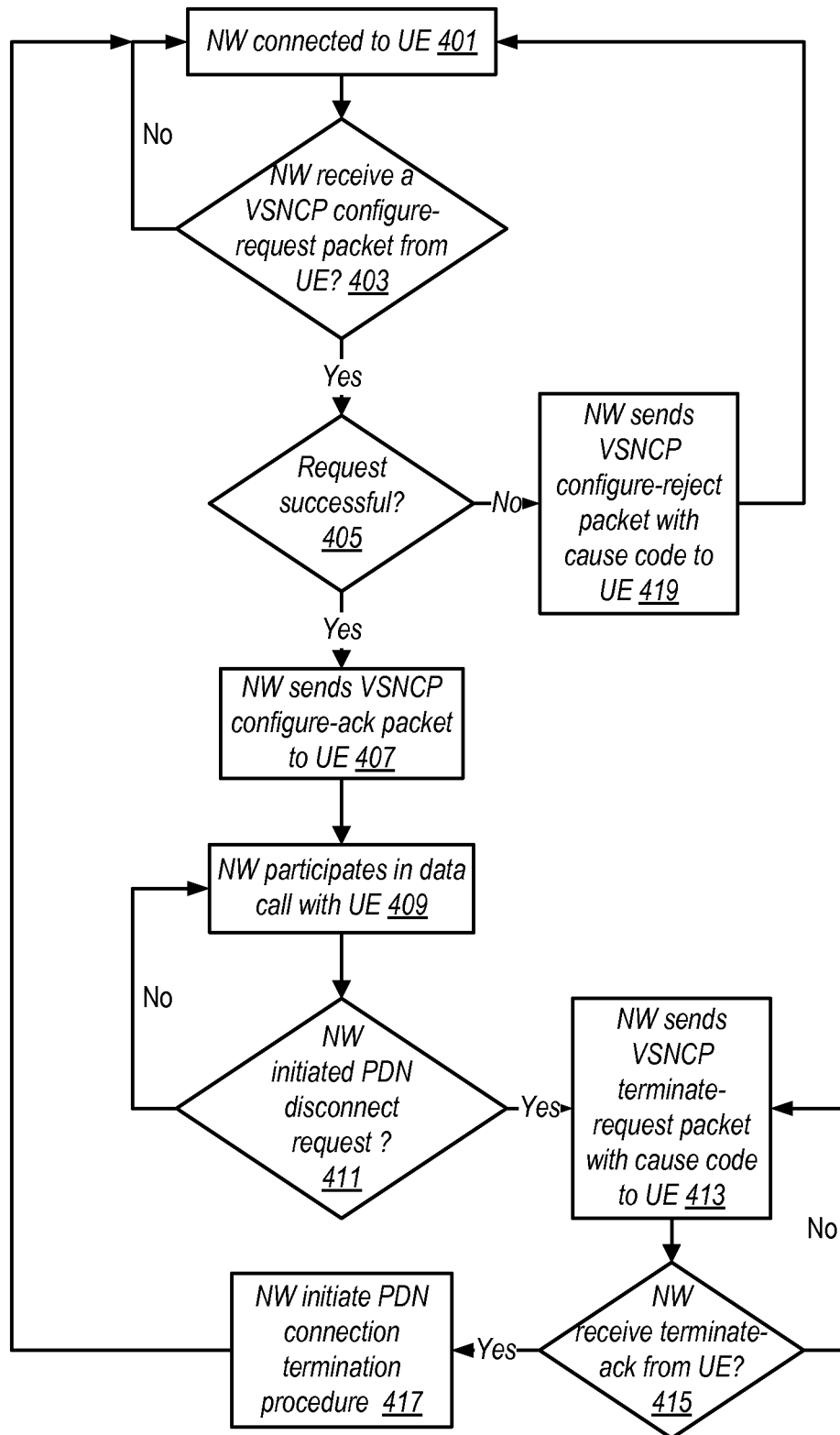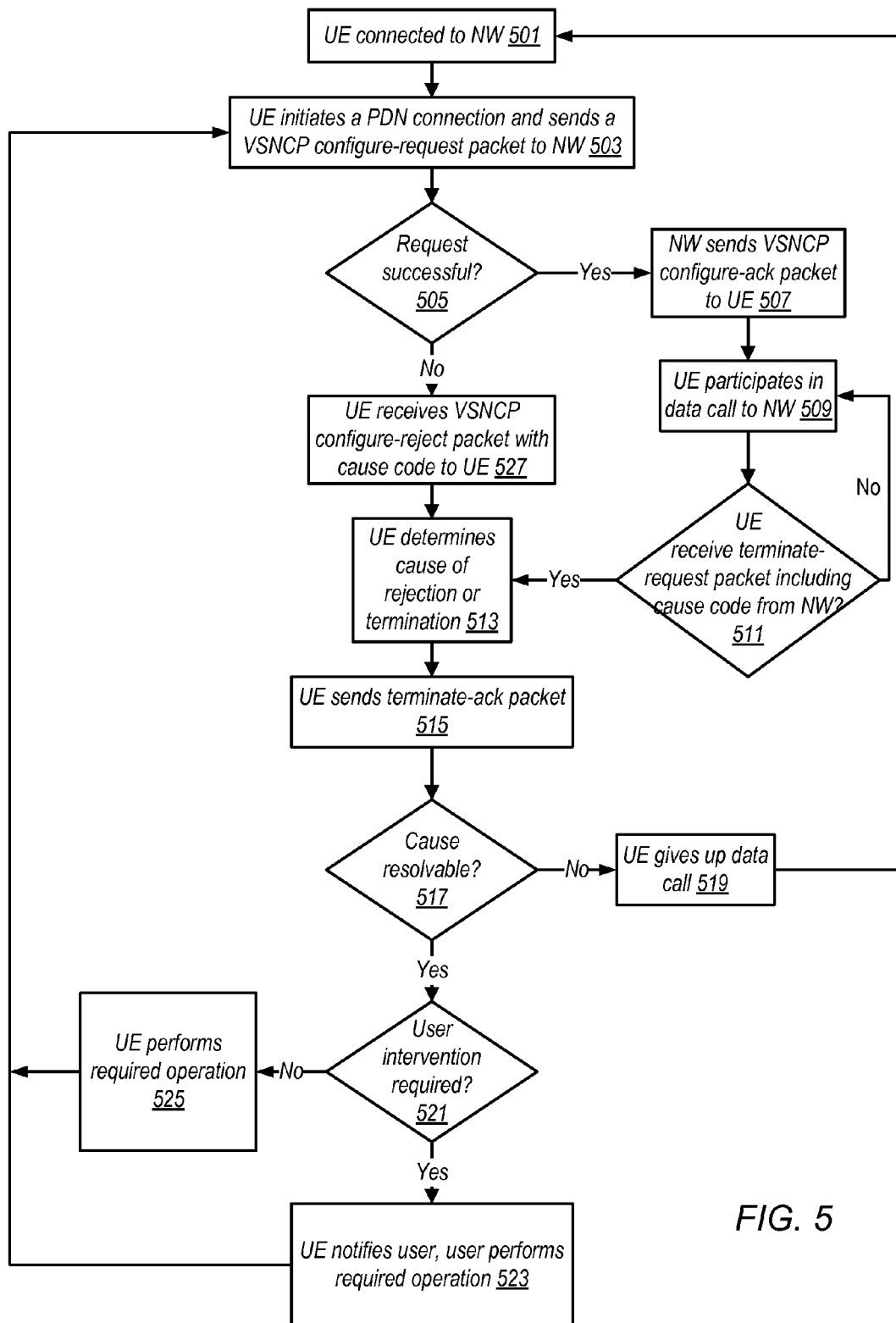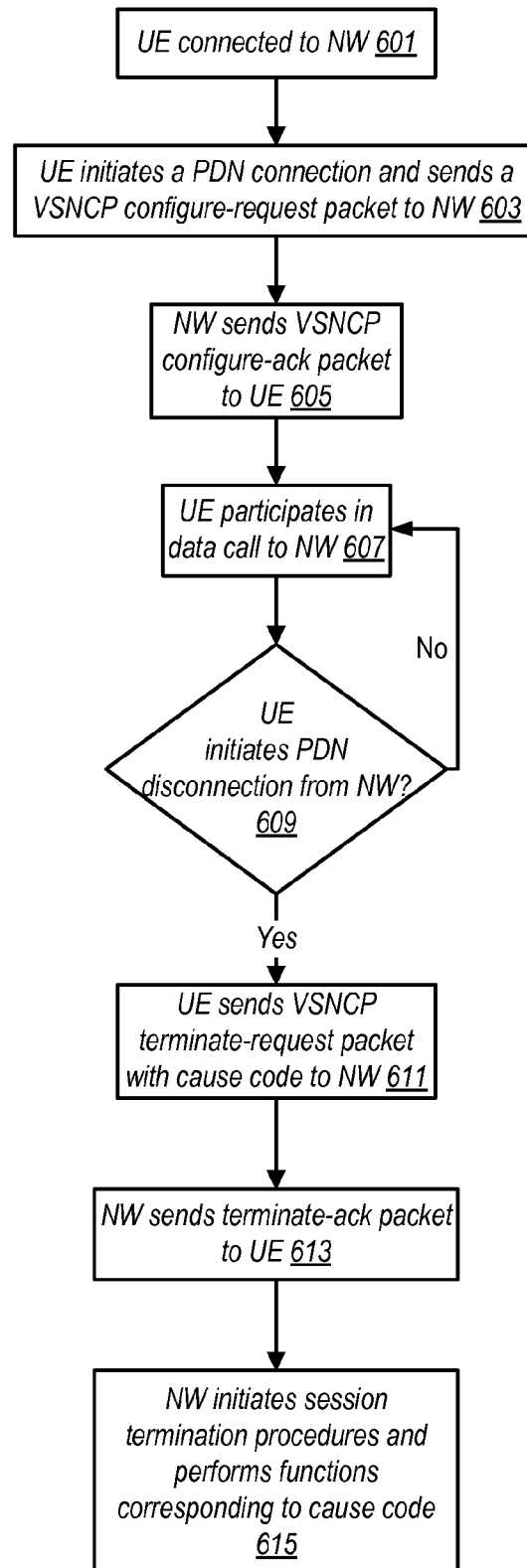|	
Code	1 through 7 (VSNCP Configure-Request, VSNCP Configure-Ack, VSNCP Configure-Nak, VSNCP Configure-Reject, VSNCP Terminate-Request, VSNCP Terminate-Ack, and VSNCP Code-Reject) as defined in RFC 3772 [58].
	Note: Code '3' (VSNCP Configure-Nak) is not specified for the 3GPP2 VSNCP protocol. The UE/HSGW receiving a 3GPP2 VSNCP packet with Code field set to '3' shall respond with a 3GPP2 VSNCP Code-Reject (Code '6') packet.
Identifier	As defined in RFC 3772 [58] and RFC 1661 [36].
Length	As defined in RFC 3772 [58] and RFC 1661 [36].
OUI	0xCF0002
Data	Zero or more configuration options

FIG. 3

NW connected to UE 401

NW receive a VSNCP configure-request packet from UE? 403

No

Request successful? 405

No

NW sends VSNCP configure-reject packet with cause code to UE 419

Yes

NW sends VSNCP configure-ack packet to UE 407

NW participates in data call with UE 409

NW initiated PDN disconnect request ? 411

No

Yes

NW sends VSNCP terminate-request packet with cause code to UE 413

NW receive terminate-ack from UE? 415

No

Yes

NW initiate PDN connection termination procedure 417

FIG. 4

UE connected to NW 501

UE initiates a PDN connection and sends a VSNCP configure-request packet to NW 503

Request successful? 505

—Yes→ NW sends VSNCP configure-ack packet to UE 507

No

UE participates in data call to NW 509

UE receives VSNCP configure-reject packet with cause code to UE 527

UE receive terminate-request packet including cause code from NW? 511

No

Yes

UE determines cause of rejection or termination 513

UE sends terminate-ack packet 515

Cause resolvable? 517

—No→ UE gives up data call 519

Yes

UE performs required operation 525

—No—

User intervention required? 521

Yes

UE notifies user, user performs required operation 523

FIG. 5

UE connected to NW 601

↓

UE initiates a PDN connection and sends a
VSNCP configure-request packet to NW 603

↓

NW sends VSNCP
configure-ack packet
to UE 605

↓

UE participates in
data call to NW 607

↓

UE
initiates PDN
disconnection from NW?
609

No →

Yes
↓

UE sends VSNCP
terminate-request packet
with cause code to NW 611

↓

NW sends terminate-ack packet
to UE 613

↓

NW initiates session
termination procedures and
performs functions
corresponding to cause code
615

FIG. 6

METHOD FOR IMPLEMENTING SPECIFIC TERMINATION CAUSE CODES IN TERMINATION REQUESTS

PRIORITY CLAIM

The present application claims benefit of priority to U.S. Provisional Application No. 61/639,714 entitled "Method for Implementing Specific Termination Cause Codes in Termination Requests" and filed on Apr. 27, 2012, whose inventors are Abhishek Sen, Madhusudan Chaudhary, Vikram B. Yerrabommanahalli, and Prashant H. Vashi, and which is hereby incorporated by reference in its entirety.

BACKGROUND

1. Technical Field

This disclosure relates to wireless communication systems and devices, and more particularly to termination cause codes and wireless device responses to them.

2. Description of the Related Art

Wireless networks continue to evolve as new communication technologies develop and standardize. Wireless network operators can deploy new communication technologies in parallel with earlier generation communication technologies, and wireless networks can support multiple communication technologies simultaneously to provide smooth transitions through multiple generations of mobile wireless devices. A representative wireless network may include simultaneous support for the 3rd Generation Partnership Project (3GPP) Long Term Evolution (LTE) wireless communication standard (which may be referred to as a 4th generation (4G) network) as well as other 3GPP, and 3GPP2 wireless communication standards such as the Enhanced High Rate Packet Data (eHRPD), for example. The 3GPP wireless communications standards organization develops mobile communication standards that include releases for Global System for Mobile Communications (GSM), General Packet Radio Service (GPRS), Universal Mobile Telecommunications System (UMTS), Long Term Evolution (LTE) and LTE Advanced standards, while the 3GPP2 wireless communications standards organization develops mobile communication standards that include CDMA2000 1xRTT and 1xEV-DO, and eHRPD standards.

When a mobile wireless device is participating in a data session or data call, and the call is terminated by a party other than the mobile device, the mobile device typically receives a termination request. Depending on the wireless communication standard according to which the mobile device may be operating, the mobile device may or may not know the cause of the termination and subsequent tear down. This can be problematic, and at the very least may cause unnecessary and unacceptable retries to re-establish the data call.

SUMMARY OF THE EMBODIMENTS

Various embodiments of a method for implementing specific termination cause codes in termination requests are disclosed. Broadly speaking, a method is contemplated in which a wireless mobile device may be communicating with a wireless network through a packet data network (PDN) connection via an evolved high rate packet data (eHRPD) interface. During the PDN connection, the wireless mobile device may receive a vendor specific network control protocol (VSNCP) packet that indicates the wireless network has requested a PDN disconnection. For example, the VSNCP packet may correspond to a VSNCP terminate-request packet. The

VSNCP packet includes a cause code that indicates a reason for the PDN disconnection request. The wireless device may use the cause code to determine the reason for the PDN disconnection request. Accordingly, in response to receiving the VSNCP packet, the wireless mobile device may perform one or more operations in an effort to resolve any issues that may have caused the PDN disconnection request.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a block diagram of one embodiment of a wireless communication system.

FIG. 2 is a block diagram of one embodiment of a wireless communication device shown in FIG. 1.

FIG. 3 is a diagram of one embodiment of a VSNCP packet.

FIG. 4 is a flow diagram depicting the operation of one embodiment of the wireless network shown in FIG. 1.

FIG. 5 is a flow diagram depicting the operation of one embodiment of the wireless communication device shown in FIG. 1 and FIG. 2.

FIG. 6 a flow diagram depicting the operation of another embodiment of the wireless communication device shown in FIG. 1 and FIG. 2.

Specific embodiments are shown by way of example in the drawings and will herein be described in detail. It should be understood, however, that the drawings and detailed description are not intended to limit the claims to the particular embodiments disclosed, even where only a single embodiment is described with respect to a particular feature. On the contrary, the intention is to cover all modifications, equivalents and alternatives that would be apparent to a person skilled in the art having the benefit of this disclosure. Examples of features provided in the disclosure are intended to be illustrative rather than restrictive unless stated otherwise.

As used throughout this application, the word "may" is used in a permissive sense (i.e., meaning having the potential to), rather than the mandatory sense (i.e., meaning must). Similarly, the words "include," "including," and "includes" mean including, but not limited to.

Various units, circuits, or other components may be described as "configured to" perform a task or tasks. In such contexts, "configured to" is a broad recitation of structure generally meaning "having circuitry that" performs the task or tasks during operation. As such, the unit/circuit/component can be configured to perform the task even when the unit/circuit/component is not currently on. In general, the circuitry that forms the structure corresponding to "configured to" may include hardware circuits. Similarly, various units/circuits/components may be described as performing a task or tasks, for convenience in the description. Such descriptions should be interpreted as including the phrase "configured to." Reciting a unit/circuit/component that is configured to perform one or more tasks is expressly intended not to invoke 35 U.S.C. §112, paragraph six, interpretation for that unit/circuit/component.

The scope of the present disclosure includes any feature or combination of features disclosed herein (either explicitly or implicitly), or any generalization thereof, whether or not it mitigates any or all of the problems addressed herein. Accordingly, new claims may be formulated during prosecution of this application (or an application claiming priority thereto) to any such combination of features. In particular, with reference to the appended claims, features from dependent claims may be combined with those of the independent claims and features from respective independent claims may

be combined in any appropriate manner and not merely in the specific combinations enumerated in the appended claims.

DETAILED DESCRIPTION

As mentioned above, when participating in a data call according to some wireless communication standards, the wireless device may not receive a termination cause with a termination request. More particularly, when communicating with a network according to the eHRPD standard, the wireless mobile device may receive a vendor specific network control protocol (VSNCP) packet that includes a termination request. However, the VSNCP packet does not include a termination cause code. Thus, the wireless mobile device does not know whether to retry immediately, wait for some back off time to retry, accept the tear down and give up the data call, or accept the data call tear down and close the connection.

Thus to more efficiently manage wireless device operation in response to a termination request, in the following embodiments of FIG. 1 through FIG. 5, a wireless communication system and device are described in which a wireless device may be notified of the termination cause. In response, the wireless device may respond in a variety of ways depending on the termination cause. Similarly, as shown in FIG. 6 the wireless device may initiate a termination request, and the network may be notified of the termination cause.

Turning now to FIG. 1, a block diagram of one embodiment of a wireless communication system is shown. It is noted that the system of FIG. 1 is merely one example of any of a variety of wireless communication systems. The wireless communication system 10 includes a base station 102 which communicates over a wireless transmission medium (e.g., over the air interface) (as indicated by the zig-zag) with one or more user equipment (UE) devices (e.g., 106A through 106N). The base station 102 is also coupled a network 100 via another interface, which may be wired or wireless. It is noted that components identified by reference designators that include both a number and a letter may be referred to by the number only where appropriate.

The base station 102 may be a base transceiver station (BTS) or cell site, and may include hardware that enables wireless communication with one or more of the UEs 106. The base station 102 may also be equipped to communicate with the network 100. Thus, the base station 102 may facilitate communication between the UEs 106 and/or between the UEs 106 and the network 100. The communication area (or coverage area) of the base station 102 may be referred to as a "cell." In various embodiments, the base station 102 and the UEs may be configured to communicate over the transmission medium using any of various wireless communication radio access technologies such as LTE, eHRPD, GSM, CDMA, WLL, WAN, WiFi, WiMAX, etc. In embodiments that communicate using the eHRPD standard, the BTS 102 may be referred to as an HRPD BTS, and the network 100 may include an eAN/ePCF and a number of gateways including HRPD gateway (HSGW), a PDN gateway (P-GW), and a number of policy and packet control functions that may be associated with a service provider, for example.

In one embodiment, each of the UEs 106A-106N may be representative of a device with wireless network connectivity such as a mobile phone, a hand-held device, a computer or a tablet, or virtually any type of wireless device. As described further below, the UE 106 may include at least one processor (shown in FIG. 2) that is configured to execute program instructions stored in a memory (also shown in FIG. 2). Accordingly, in some embodiments, the UE 106 may perform

one or more portions of the functionality described below by executing such stored instructions. However, in other embodiments, the UE 106 may include one or more hardware elements and/or one or more programmable hardware elements such as an FPGA (field-programmable gate array) that may be configured to perform the one or more portions the functionality described below. In still other embodiments, any combination of hardware and software may be implemented to perform the functionality described below.

As described further below in conjunction with the descriptions of FIG. 2 through FIG. 4, in some embodiments, when the UE 106 is either attempting to initiate a PDN data session or "data call" with the network 100 or the data call is in progress, the UE 106 may be configured to respond in a particular way to a termination request from the network 100 that includes a specific termination cause code. More particularly, the UE 106 may initiate a PDN data session using, for example, a VSNCP point-to-point (PPP) procedure. The VSNCP procedures include a number of procedures to bring up, tear down, and reconfigure data calls, among other things. This VSNCP mechanism allows the UE 106, which may be camped or listening on the eHRPD system, to originate a data call using an access point name (APN). This may allow the UE 106 to roam on an LTE network, in the event that an Inter-radio access technology (I-RAT) handover procedure becomes necessary. A disconnection of a PDN connection or data call may be initiated by the UE 106 or by the network 100. The network 100 may terminate the data call for a variety of reasons. Accordingly, as described further below, the network 100 may send to the UE 106 a termination request that includes a specific termination cause code (shown in Table 1 below). The UE 106 may determine a specific response that corresponds to the specific termination cause code, and then perform one or more operations, including sending a termination acknowledgement to the network 100. In one embodiment, the UE 106 may automatically, and without user intervention, determine the specific response, initiate the appropriate actions. It is noted that in one embodiment, the network 100 may implement the eHRPD wireless communication standard as specified in the latest revision of the 3GPP2 X.S0057-0 specification.

Referring to FIG. 2, a block diagram of one embodiment of a user equipment device shown in FIG. 1 is shown. It is noted that components that correspond to components shown in FIG. 1 are numbered identically for clarity and simplicity. The UE 106 includes processor(s) 202 (or processor core(s) 202) which is coupled to display circuitry 204 which is in turn coupled to the display 240. The processor(s) 202 is also coupled to a memory management unit (MMU) 220 and to a receiver/transmitter (R/T) unit 230. The MMU 220 is coupled to a memory 206. The UE 106 also includes an I/O interface 210 that is coupled to the processor(s) 202, and may be used for coupling the UE 106 to a computer system, or other external device. It is noted that in one embodiment the components shown within UE 106 of FIG. 2 may be manufactured as stand alone components. However, it is contemplated that in other embodiments various ones of the components may be part of one or more chipsets, or they may be part of a system on chip (SOC) implementation.

In various embodiments, the processors 202 may be representative of a number of different types of processors that may be found in a wireless communications device. For example, processor(s) 202 may include general processing capability, digital signal processing capability, as well as hardware accelerator functionality, as desired. The processor(s) 202 may include baseband processing and therefore may digitally process the signals received by the R/T unit 230. The

5

6

processor(s) **202** may also process data that may be transmitted by the R/T unit **230**. The processor(s) **202** may also perform a number of other data processing function such as running operating system and user applications for the UE **106**.

In one embodiment, the MMU **220** may be configured to receive addresses from the processor(s) **202** and to translate those addresses to locations in memory (e.g., memory **206**) and/or to other circuits or devices, such as the display circuitry **204**, R/T unit **230**, and/or display **240**. The MMU **220** may also return data to the processor(s) **202** from the locations in memory **206**. The MMU **220** may be configured to perform memory protection and page table translation or set up. In some embodiments, the MMU **220** may be included as a portion of the processor(s) **202**. The display circuit **204** may be configured to perform graphics processing and provide display signals to the display **240**.

The R/T unit **230** may, in one embodiment, include analog radio frequency (RF) circuitry for receiving and transmitting RF signals via the antenna **235** to perform the wireless communication. The R/T unit **230** may also include down-conversion circuitry to lower the incoming RF signals to the baseband or intermediate frequency (IF) as desired. For example, the R/T unit **230** may include various RF and IF filters, local oscillators, mixers, and the like. Since the UE **106** may operate according to a number of radio access technologies, the R/T unit **230** may include a corresponding number of RF front end portions to receive and down-convert, as well as up-convert and transmit the respective RF signals of each technology.

In various embodiments, the processor(s) **202** may execute software stored within a memory such as memory **206**, for example, to perform functionality associated with responding to a termination request as mentioned above. In other embodiments however, the UE **106** may include hardware associated with the processor(s) **202** and/or the R/T **230** to perform functionality associated with responding to a termination request as mentioned above. In still other embodiments, the UE **106** may include any suitable combination of hardware, firmware and/or software to perform functionality associated with responding to a termination request as mentioned above, and described further below in conjunction with the description of FIG. **3** through FIG. **6**.

In FIG. **3**, a diagram of one embodiment of a VSNCP packet is shown. The VSNCP packet **300** includes a number of fields. As shown in the legend of FIG. **3**, the code field may indicate what type of packet is being conveyed. In particular, a code of five corresponds to a VSNCP terminate-request. The identifier field may include an identifier that is used in matching requests and replies. The length field identifies the length of the packet in octets. The OUI field is an organizationally unique identifier that may identify a specific vendor. The data field may include zero or more configuration options. More particularly, there are a number of configuration options including PDN identifier, APN, PDN type, PDN address, Error/Cause Code, and attach type, among others.

As described briefly above, either the UE **106** or the network **100** may initiate such a packet. For embodiments in which the network **100** issues a VSNCP terminate-request packet, the data field of the packet includes a configuration option that identifies a termination cause code. It is noted that there are a number of termination options. For termination request packets, cause codes may be used that identify the cause of the termination request. Some example termination cause codes are shown in Table 1 below. Similarly, configure-reject packets may also include cause codes in addition to the error codes that may already be sent. More particularly, there

may be vendor or operator-specific cause codes that may be sent that are particular to a given operator agreement, for example. These cause codes may enable the UE **106** to determine with some certainty the reason for the termination or configure rejection, thereby allowing the UE **106** to more efficiently utilize its resources to either re-establish a PDN connection or give up on the PDN connection.

TABLE 1

Example eHRPD Termination Cause Codes	
Value	Description
0	Insufficient Resources
1	Network Congestion
2	Service Option temporarily out of order
3	Subscriber has run out of prepaid data
4	Network Failure
5	Network dormancy timer expired
6	Regular teardown
7	General Error
8	PDN Limit Exceeded - Number of connections for this PDN has exceeded the maximum allowed limit
9	Device dormancy timer expired
10	Admin prohibited

In FIG. **4**, a flow diagram depicting the operation of one embodiment of the network equipment of FIG. **1** is shown. Referring collectively to FIG. **1**, FIG. **3**, and FIG. **4** and beginning in block **401** of FIG. **4**, a wireless network **100** (e.g., NW in FIG. **4**) using, for example, the eHRPD protocol may be connected to the UE **106** via a PPP connection. More particularly, in one embodiment the UE **106** may be camped on the connection. Generally, a wireless mobile device such as UE **106** may be considered to be camping on a connection when the mobile device is listening or monitoring one or more control channels and is not transmitting, except as required by the network.

At some point, the network **100** may receive a VSNCP configure-request packet at the HSGW of the network **100** via the base station **102** (block **403**). More particularly, in one embodiment, a user or an application executing on the UE **106** may initiate a PDN connection (IP) request to an APN of the network **100**. If the request is not successful (block **405**), the network **100** may send a VSNCP configure-reject packet to the UE **106**. In one embodiment, the network **100** may include error codes and/or cause codes in the VSNCP configure-reject packet to enable the UE **106** to determine a best course of action to resolve the problem. Operation proceeds as described above in conjunction with the description of block **401**.

However, if the request is successful (block **405**), the network **100** may send a VSNCP configure-ack packet to the UE **106** (block **407**), and the network **100** participates in the PDN connection with the UE **106** (block **409**). During the data call, either the UE **106** or the network **100** may terminate the PDN connection. Accordingly, if the network **100** initiates the termination (block **411**), the network **100** may send a VSNCP terminate-request packet including one or more cause codes such as the cause codes shown in Table 1, for example, to the UE **106** (block **413**). In one embodiment, the network **100** may continue sending VSNCP terminate-request packets until the network **100** receives a terminate-ack packet from the UE **106** (block **415**). Once the network **100** receives the terminate-ack packet, the network **100** may initiate a PDN connection termination (i.e., tear down) procedure. If the PPP link is still active, operation proceeds as described above in conjunction with the description of block **401**.

In FIG. **5**, a flow diagram depicting the operation of one embodiment of the wireless user equipment device of FIG. **1** and FIG. **2** is shown. Referring collectively to FIG. **1** through FIG. **3**, and FIG. **5** and beginning in block **501** of FIG. **5**, the UE **106** may be connected via a PPP connection to a wireless network (e.g., NW) using, for example, the eHRPD protocol. More particularly, in one embodiment the UE **106** may be camped on the connection as described above.

At some point, a user or an application executing on the UE **106** may initiate a PDN connection (IP) request to an APN of the network **100** by sending a VSNCP configure-request packet to the HSGW of the network **100** via the base station **102** (block **503**). If the request is successful (block **505**), the network **100** sends a VSNCP configure-ack packet to the UE **106** (block **507**). It is noted that the network **100** may send an additional VSNCP configure-request packet to the UE **106** to request additional configuration information. When the network **100** receives a second VSNCP configure-ack packet, the network **100** may complete IP (v4 or v6) address allocation. The UE **106** may then participate in the PDN data call through the network **100** (block **509**).

While on the data call, the network **100** may initiate a PDN disconnection procedure. If the UE **106** receives a terminate-request packet from the network **100** (block **511**) the UE **106** may try to determine the cause of the termination request, based upon the cause code included in the packet (block **513**). More particularly, in one embodiment, depending on which entity of the network **100** initiated the termination, the termination cause may be different. For example, the Authentication, Authorization, Accounting/Home Subscriber Server AAA/HSS may initiate the termination request for a variety of reasons such as the user subscription is invalid, the subscription has run out of funds, or there is an authentication time out. In addition to the AAA/HSS, the P-GW may initiate the request, or the HSGW may initiate the request if, for example, the associated PPP session has terminated. It is noted that there may be many additional reasons. Accordingly, there may be a number of general cause codes, as well as operator and vendor specific cause codes. Once the UE **106** determines the cause of the termination, the UE **1067** may send a terminate-ack packet to the network **100** (block **515**). It is noted that in other embodiments, the UE **106** may send the terminate-ack packet immediately and prior to determining the cause.

The UE **106** may determine whether or not the termination cause is resolvable (block **517**). More particularly, in some cases, the termination cause may not be resolvable such as the case when the PPP connection is dropped, for example. In such cases, the UE **106** may give up the call and forego any retry of the PDN data call (block **519**). In one embodiment, the UE **106** may notify the user via any of a variety of alerts and/or notification mechanisms. Operation may then proceed as described above in conjunction with the description of block **501**. However, if the termination cause is resolvable (block **517**), the UE **106** determines whether user intervention is required. If user intervention is not required (block **521**), the UE **106** may perform any necessary operations and then attempts to re-initialize the PDN connection (block **525**). More particularly, in one embodiment, if the user has run out of data according to their subscription plan, the terminate-request packet may have included a cause code that indicates, for example, "no user data usage remaining." The UE **106** may launch an application that includes predetermined user configuration and preferences. The application may automatically access and replenish the user's subscription account, based on these preferences and configuration data. Accordingly, depending upon the specific cause codes

received, the UE **106** may respond in an appropriate way, and in an automated fashion. Thus, once the operations are performed to resolve the issue, the UE **106** may reinitiate the PDN connection as described above in conjunction with the description of block **503**.

Referring back to block **521**, if user intervention is required to resolve the issue, the UE **106** may notify the user through an onscreen alert or other notification mechanism. The user may then perform any necessary operations and then attempt to re-initialize the PDN connection (block **523**). Once the operations are performed to resolve the issue, the UE **106** may reinitiate the PDN connection as described above in conjunction with the description of block **503**.

Referring back to block **505**, if the request is not successful, the UE **106** may receive a VSNCP configure-reject packet from the network **100** (block **527**). In one embodiment, the configure-reject packet may include error codes and cause codes that identify the reason for the rejection. As described above in conjunction with the description beginning at block **513**, the UE **106** may determine the cause of the rejection, and then determine whether it is a resolvable issue, etc.

Accordingly, when a network such as network **100** provides cause codes in the VSNCP terminate-request packets and configure-reject packets, the UE **106** may be able to respond in a proactive way to re-establish a PDN connection in less time, or to at least know with some certainty that the PDN connection should be abandoned.

As mentioned above, the UE **106** may also initiate a PDN disconnection request. Accordingly, in one embodiment, the UE **106** may include a cause code in the termination request. In FIG. **6**, a flow diagram depicting the operation of another embodiment of the wireless communication device of FIG. **1** and FIG. **2** is shown. Referring collectively to FIG. **1** through FIG. **3**, and FIG. **6** and beginning in block **601** of FIG. **6**, the UE **106** may be connected via a PPP connection to a wireless network (e.g., NW) using, for example, the eHRPD protocol. More particularly, in one embodiment the UE **106** may be camped on the connection as described above.

At some point, a user or an application executing on the UE **106** may initiate a PDN connection (IP) request to an APN of the network **100** by sending a VSNCP configure-request packet to the HSGW of the network **100** via the base station **102** (block **603**). If the request is successful, the network **100** sends a VSNCP configure-ack packet to the UE **106** (block **605**). It is noted that the network **100** may send an additional VSNCP configure-request packet to the UE **106** to request additional configuration information. When the network **100** receives a second VSNCP configure-ack packet, the network **100** may complete IP (v4 or v6) address allocation. The UE **106** may then participate in the PDN data call through the network **100** (block **607**).

While on the data call, the UE **106** may initiate a PDN disconnection procedure. If the UE **106** initiates the PDN disconnection (block **609**), the UE **106** will send a terminate-request packet to the network **100** (block **611**). More particularly, in one embodiment, the UE **106** may include a cause code in the termination request. In response the network **100** may send a terminate-ack packet (block **613**). The network **100** may then initiate session termination procedures and perform various functions associated with the gateway's identity, APN and PDN connection. The network **100** may use the termination cause code during execution of the termination procedures.

Although the embodiments above have been described in considerable detail, numerous variations and modifications will become apparent to those skilled in the art once the above

disclosure is fully appreciated. It is intended that the following claims be interpreted to embrace all such variations and modifications.

What is claimed is:

1. A method comprising:
a wireless mobile device communicating with a packet data network (PDN) through a wireless network via an evolved high rate packet data (eHRPD) interface;
the wireless mobile device receiving a vendor specific network control protocol (VSNCP) packet that indicates the wireless network has requested a PDN disconnection;
wherein the VSNCP packet includes a cause code that indicates a reason for the PDN disconnection request;
the wireless mobile device determining if the reason for the PDN disconnection request is resolvable dependent upon the cause code; and
the wireless mobile device performing one or more operations to resolve the reason for the PDN disconnection request in response to determining that the reason for the PDN disconnection request is resolvable.

2. The method of claim 1, wherein the eHRPD interface conforms to a latest version of a 3rd Generation Partnership Project 2 (3GPP2) X.S0057-0 specification.

3. The method of claim 1, wherein the VSNCP packet corresponds to a VSNCP terminate-request packet.

4. The method of claim 1, further comprising the wireless mobile device accessing one or more user configuration files to automatically and without user intervention resolve the reason for the PDN disconnection request, wherein the one or more user configuration files includes information regarding replenishing a subscription account.

5. The method of claim 1, further comprising the wireless mobile device accessing one or more user configuration files and notifying a user of the reason for the PDN disconnection request.

6. The method of claim 1, further comprising the wireless mobile device aborting a connection to the PDN in response to determining that the reason for the PDN disconnection request is not resolvable.

7. A wireless mobile device comprising:
a receiver/transmitter; and
a processor coupled to the receiver/transmitter and configured to communicate with a packet data network (PDN) through a wireless network via an evolved high rate packet data (eHRPD) interface;
wherein the processor is configured to receive a vendor specific network control protocol (VSNCP) packet that indicates the wireless network has requested a PDN disconnection;
wherein the VSNCP packet includes a cause code that indicates a reason for the PDN disconnection request;
wherein the processor is further configured to determine if the reason for the PDN disconnection request is resolvable dependent upon the cause code; and
wherein the processor is further configured to perform one or more operations to resolve the reason for the PDN disconnection request in response to determining that the reason for the PDN disconnection request is resolvable.

8. The wireless mobile device of claim 7, wherein the eHRPD interface conforms to a latest version of a 3rd Generation Partnership Project 2 (3GPP2) X.S0057-0 specification.

9. The wireless mobile device of claim 7, wherein the VSNCP packet corresponds to a VSNCP terminate-request packet.

10. The wireless mobile device of claim 7, further comprising a memory coupled to the processor, wherein the processor is further configured to access one or more user configuration files stored within the memory to automatically and without user intervention resolve the reason for the PDN disconnection request.

11. The wireless mobile device of claim 7, further comprising a memory coupled to the processor, wherein the processor is further configured to access one or more user configuration files stored within the memory and to notify a user of the reason for the PDN disconnection request.

12. The wireless mobile device of claim 7, wherein the processor is further configured to initiate sending via the wireless network a terminate-acknowledge packet.

13. The wireless mobile device of claim 7, wherein the processor is further configured to launch an application that includes predetermined user configuration and preference information, wherein the processor is configured to automatically access and replenish a user's subscription account, based upon the user configuration and preference information.

14. A method comprising:
a wireless network communicating with a packet data network (PDN) and with a wireless mobile device via an evolved high rate packet data (eHRPD) interface;
the wireless network initiating a PDN disconnection and sending to the wireless mobile device a vendor specific network control protocol (VSNCP) packet requesting the PDN disconnection;
wherein the VSNCP packet includes a cause code that indicates a reason for the PDN disconnection request;
the wireless network resending the VSNCP packet in response to determining the wireless mobile device did not respond with an acknowledgement packet.

15. The method of claim 14, wherein the eHRPD interface conforms to a latest version of a 3rd Generation Partnership Project 2 (3GPP2) X.S0057-0 specification.

16. The method of claim 14, wherein the VSNCP packet corresponds to a VSNCP terminate-request packet.

17. A method comprising:
a wireless mobile device communicating through a point-to-point (PPP) connection with a wireless network via an evolved high rate packet data (eHRPD) interface;
the wireless mobile device sending a PDN connection request to the wireless network;
the wireless mobile device receiving a vendor specific network control protocol (VSNCP) packet including a cause code indicating a reason that the PDN connection request is rejected;
the wireless mobile device automatically determining whether the PDN connection request rejection is resolvable dependent upon the cause code; and
the wireless mobile device performing one or more operations to resolve the reason for the PDN connection request rejection in response to determining that the reason for the PDN connection request rejection is resolvable.

18. The method of claim 17, wherein the VSNCP packet corresponds to a VSNCP configure-reject packet.

19. The method of claim 17, further comprising the wireless mobile device notifying a user in response to determining that the PDN connection request rejection is not resolvable.

20. The method of claim 17, wherein the one or more operations to resolve the reason for the PDN connection request rejection includes the wireless mobile device accessing one or more user configuration files to automatically and without user intervention resolve the reason for the PDN

connection request rejection, wherein the one or more user configuration files includes information regarding replenishing a subscription account.

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